Five hundred and fifty-eighth Meeting.

November 14, 1865. — MONTHLY MEETING.

The PRESIDENT in the chair.

The President called the attention of the Academy to the recent decease of the eminent lexicographer Dr. Joseph E. Worcester, of the Resident Fellows.

Professor Lovering, from the Rumford Committee, delivered to the President the Rumford Medal, which had been prepared in accordance with a vote of the Academy to be presented to Professor Treadwell.

The President prefaced the presentation of this medal with the following remarks: —

At the Anniversary Meeting last May, upon the unanimous recommendation of our Rumford Committee, the medal founded by Count Rumford was by the Academy awarded to Professor Daniel Treadwell for certain improvements in the management of heat. This medal is now before us. It is the first which the Academy has ever bestowed upon one of its immediate members.

As your organ upon this occasion, before we place this testimonial in the hands of our distinguished associate, it is proper that I should briefly specify the grounds upon which your Committee proposed, and you made, this award. It is well understood, and the terms of the vote distinctly show, that this medal was awarded for an invention or an improvement in the management of heat. It is also well known that this particular improvement is a part — the initial part, indeed — of a series of inventions, — applicable to other uses, no doubt, — but through which the character of ordnance has been changed, and its power immensely increased. This was the end and aim of the improvement for which the medal is given.

We may, therefore, and we must upon this occasion, speak of this particular improvement in the management of heat in connection with the mechanical inventions which accompanied and followed it, and to which indeed the former is incidental. For the whole important series of mechanical inventions which I am to recapitulate, the Academy must regret that it has no honors which it can bestow. But their history is upon our records, embodied in the communications addressed to

us by their author from time to time; and we can only hope that the country and the world, when at length sensible of their obligations, may render the tardy meed of justice, if not of gratitude.

In his earliest communication, — a pamphlet published in the year 1845, — Mr. Treadwell seems to think that the appropriateness of the term "useful," as applied to an improvement in implements of destruction, may be questioned. We need have no misgiving in this respect. So long as life and property, which the ravages of war destroy, are not the most valuable of human possessions, they may be justly yielded and taken, if need require, for the preservation of those that are. And so nations must always count among their greatest benefactors those whose inventions increase their strength and defence in war. And certainly those men who, by their inventive genius, revolutionize the art of war, exert a most powerful and enduring influence upon the fate of empires, the course of history, and the progress of civilization.

We in our day, within the last fifteen years, have witnessed a change in the means of attack and defence greater than any made in the two hundred years previous, — a change involving a complete revolution in tactics, both on land and on sea. To take a single illustration from heavy ordnance, — in which the importance of the change impresses us when we are told that our strongest forts, armed with the best guns we had ten years ago, could oppose no effectual resistance to the entrance of such ships as are now built into any of our harbors; and that a ship could now be built and armed, which, singly, would overmatch our whole navy as it was in 1855.

Fortunately, the balance is redressed by equal improvements in defence.

The improvement in fire-arms, both great and small, is in their increased range and precision. When the effective range of a musket-bullet was extended from two hundred yards to fourteen hundred or more, it became imperatively necessary that ordnance should be improved in the same ratio, or it would be useless, as gunners and horses would be picked off by small arms long before they could effectively reach the enemy. This improvement in guns of great calibre has been made, with consequences the importance of which, present and prospective, cannot be over-estimated.

But the point which we have to consider is, that this increased range and precision are entirely dependent on the augmented strength of the gun. The weakness of the gun is the only thing that imposes a limit

to the range short of the absolute strength of the explosive material used. It is the strength of the gun which not only gives the range, but makes rifling possible, with precision and all the advantages of the elongated shot. All inventions relating to the different modes of rifling, the form of the projectile, and the devices for breech-loading, are necessarily subordinate to the question of strength; with this sufficient, those become simple problems, to be rapidly determined by the ingenuity of many inventors.

Now the limit of strength of cast-iron and of bronze cannon had long ago been reached. Excepting Captain Rodman's improvement, and certain modern advantages in working and casting metals, no material advantages had been gained over guns cast in the reign of Queen Elizabeth.

But the most effective guns of the present day embody new principles of strength. They are all *built-up* guns. With them are associated the names of Armstrong, Blakely, Whitworth, Parrott, and others. Whatever may be the relative merits of these several varieties, our interest is confined to the question of their strength, that is, to the principles of construction which have made them stronger than common guns, and rendered their respective subordinate improvements possible. These principles are two, and their introduction at different times into the manufacture of cannon constitutes two successive steps, and the only steps, which give distinctive character to the guns under consideration. Both originated with Mr. Treadwell.

These two inventions are often confounded, although more than ten years elapsed between them. The confusion is doubtless owing in some degree to the fact that the two are found combined in nearly all the modern built-up guns. The first initiated a system of construction which may be designated as the *coil system;* the second, what may be named the *hoop system.*

The first was successfully applied to the making of cannon by Mr. Treadwell in the year 1842, and a full account of it was published in 1845; the gist of the invention being in so constructing the gun that the fibres of the material shall be directed around the axis of the calibre.

This method of construction is described in Professor Treadwell's own language as follows: "Between the years 1841 and 1845 I made upwards of twenty cannon of this material [wrought iron]. They were all made up of rings, or short hollow cylinders, welded together

endwise; each ring was made of bars wound upon an arbor spirally, like winding a ribbon upon a block, and, being welded and shaped in dies, were joined endwise when in the furnace at a welding heat, and afterwards pressed together in a mould by a hydrostatic press of one thousand tons' force.

"Finding in the early stage of the manufacture that the softness of the wrought iron was a serious defect, I formed those made afterwards with a lining of steel, the wrought-iron bars being wound upon a previously formed steel ring. Eight of these guns were six-pounders of the common United States bronze pattern, and eleven were thirty-two-pounders, of about eighty inches' length of bore and nineteen hundred pounds' weight."

The soundness and value of this principle of construction were fully confirmed in England by the experiments of Sir William Armstrong in 1855, and attested by his evidence before a committee of the House of Commons in 1863. He there describes his own gun as one "with a steel tube surrounded with coiled cylinders," — as "peculiar in being mainly composed of tubes, or pipes, or cylinders, formed by coiling spirally long bars of iron into tubes and welding them on the edges, as is done in gun-barrels." His indirect testimony to the originality of Mr. Treadwell's process is equally clear, being that, within his knowledge, no cannon had ever been made upon this principle until he made his own in 1855, — he being, as we must suppose, ignorant of what Mr. Treadwell had done thirteen years before. The statement of Mr. Anderson (witness before the Commons' Select Committee), made before the Institute of Civil Engineers in 1860, is equally explicit as to the nature and value of this method of constructing cannon. And, finally, the high estimate of its importance abroad is shown not only by the honors and emoluments conferred by the British government on the re-inventor, but still more by the actual adoption of this gun as the most efficient arm yet produced. For it must be borne in mind that the faults or failures, complete or partial, of the Armstrong and similar guns are not of the cannon itself, as originally constructed, but of breech-loading contrivances, of the lead coating of the projectile, or of other subsidiary matters.

That our colleague's original invention, the value of which is now so clearly established, should have been so generally unacknowledged by inventors abroad is his misfortune, not his fault. For, not only were his guns made and tested here, and their strength as clearly demon-

strated before 1845 as they have been since, not only was a full account of the process and of the results published here in that year, but a French translation of his pamphlet was published in Paris, in 1848, by a professor in the school of artillery at Vincennes; and Mr. Treadwell's patent, with full specifications, was published in England before Sir William Armstrong began his experiments.

The difficulties to be overcome in making such a gun, — great at all times, as Sir William Armstrong and Mr. Anderson testify, — were far greater in 1842 than in 1863. These difficulties were mainly, if not wholly, in welding large masses of wrought iron in the shape of tubes or cylinders. It is for overcoming these difficulties that this medal is bestowed, and especially for the means and appliances by which this difficult mechanical achievement was effected in the furnace "by the agency of fire."

An incidental but noteworthy part of the improvement was the welding by hydrostatic pressure, — an operation which is just now coming into use in England, but has not yet attracted attention in this country.

We come now to the second improvement in the construction of artillery, — the invention of the *hooped gun.*

This is not always clearly distinguished, even by those occupied with the subject, from the gun formed of coiled rings. But a simple statement will bring into view distinctly the new principle of strength here introduced.

If an elastic hollow cylinder be subjected to internal fluid pressure, the successive cylindrical layers of the material composing it, counting from within outwards, will be unequally distended, and the resisting efficiency of the outer layer will be less than that of any layer nearer the axis. And if the walls of the cylinder are thick, and the internal pressure surpasses the tensile strength of the material, its inner layer will break before the outer one has been notably strained. Hence the tensile strength of a square inch bar of the material is the measure of the maximum pressure the cylinder can bear, when constructed as guns were before the introduction of the improvement now under consideration. The improvement does away with this limit, and enables us to go indefinitely beyond it.

This is accomplished by so constructing the gun that the inner layers are compressed by the outer; whereby the internal pressure is first resisted by the outer layers, which must be distended enough to allow

the internal compressed portion to attain its normal condition before this internal portion (which is the first to break in the common gun) is subject to any strain at all. It will be perceived that if this principle could be rigorously applied, a cannon could be made so perfect that, when subjected to a bursting pressure, every fibre, from the internal to the external surface would be at that instant equally extended, each contributing its full share of resistance to fracture. The whole resistance would be proportional to the area of fracture.

This was supposed to be the case in common cylinders, before the error was pointed out by Barlow, and also by Lamie and Clapeyron. And it was this erroneous supposition that led Count Rumford to his exaggerated estimate of the force of gunpowder, as tested by its power of bursting gun-barrels. If he had used the theory which gave origin to the hooped gun, his results would nearly have agreed with modern observations.

The demonstration of the superiority of the hooped gun, with detailed directions for its construction, is contained in a paper read before this Academy in February, 1856, and published at the beginning of the sixth volume of our Memoirs. This was the first published account of the invention, which had been patented nearly a year before. Captain Blakely's pamphlet, published in England in 1858, sets forth the advantages of this construction by similar arguments; as also does an elaborate paper read by Mr. Longridge before the Institution of Civil Engineers in February, 1860. Both these gentlemen, however, were engaged in researches upon this subject at an earlier date, but not so early, it would appear, as was Mr. Treadwell.

The validity of the principle, and the soundness of Mr. Treadwell's views upon the whole subject, as set forth in his memoir, have been amply confirmed by special experiments made in England with the Blakely and Whitworth guns, and by experience in this country during the last four years with the Parrott and the Blakely guns.

It must not be supposed that the earlier invention is superseded by the later one. That is used in forming the hoops of the Parrott gun, and in most of the British guns. And the best gun which could now be made, as experience has shown, would be composed of a barrel of cast-iron or steel, enclosed and compressed by a cylinder of coil.

We need not discuss the question of priority of invention between Mr. Treadwell and others, competitors for a share in the honor of producing the modern cannon. His independence of each and all of them

has never been called in question. Nor will it ever seriously be thought that the previous futile attempts at constructing wrought-iron and banded guns, — foredoomed failures both in theory and practice, and destitute of all pretension to a knowledge of the guiding principles now clearly seen to be essential to success, — should detract in the slightest degree from the great honor which our associate has, by a clear insight into the conditions of the problem and the resources of physical science, so fairly and completely won.

Upon these two inventions has been set the seal of experience. But there is still another memoir, read by Professor Treadwell before this Academy in April, 1864, and printed soon afterwards, which promises to add a third important improvement in the construction of artillery.

Perceiving that the body of a hooped gun, if made of unmalleable cast-iron, compressed by a soft wrought-iron hoop, must give way, by the fracture of the cast-iron, before the hoop can approach the ultimate limit of its strength, and that this was, in fact, a principal cause of the failure of so great a part of the large guns of Blakely and Parrott, Professor Treadwell, as the principal result of this third investigation, proceeds to show, that, to attain with effect the end sought for by hooping a cast-iron gun, it is necessary to harden the wrought-iron hoop by cold hammering and severe stretching before placing it upon the gun-body. He computes, that, by this simple means, a hooped gun may be made *more than twice as strong* as those which have been constructed by Blakely and Parrott, the materials being in both cases the same.

In this important discovery, as also in other matters discussed in his latest memoir, we are gratified to see, that, although now carrying the weight of more than threescore and ten years, our veteran colleague still keeps the lead, which he gained at the start, of his competitors in this race of improvement.

So completely do these three improvements cover the ground, that if the works of all other inventors who claim a share in the great gun of the nineteenth century were lost, the gun could be restored (rifling excepted) from Mr. Treadwell's papers alone.

And now, Mr. Treadwell, in delivering into your hands this beautiful gold medal and its silver duplicate, I have much pleasure in conveying with them the congratulations and best wishes of your associates here assembled; also the expression of their hope that you may yet longer lead the race; and especially that you may long enjoy the

scientific honors which you have worthily won; and with them, if it may be so, the full recognition of the rights, and possession of the advantages, which pertain to your inventions.

On receiving the medal, Mr. Treadwell expressed his acknowledgments as follows: —

Mr. President and Gentlemen of the Academy: —

I receive with great satisfaction the Rumford Medal which, in accordance with a vote passed at the Annual Meeting, you have now presented to me. I prize this premium the more as coming from this body, with which I have been intimately associated for more than forty years as an active member, and for a very large part of the time as an office-bearer. I may be permitted to say, however, that, although I am sensible that I am indebted for this award in a large degree to your kind partiality for an old associate, which turned your attention to his labors, yet it was made not only without any application on my part, but your motion towards it was wholly unknown, and not even thought of by me, until the vote of the Rumford Committee was communicated to me.

The award was, as stated in your vote, (which uses the language of Count Rumford,) for "improvements in the management of heat." But as this management of heat was incidental to, and intimately connected with, improvements in the construction of cannon, to which I had given years of labor, you have extended your examination into the character of those improvements generally. For the very thorough research which it is evident you have made into the whole subject, I feel under great obligations to you; and the very favorable conclusions which you have reached, and which have been so fully and kindly expressed by you, Sir, as to the originality and value of my researches and labors, form an additional source of satisfaction to me. This, taken alone, would constitute one of the most welcome recognitions and rewards that could be given to me. Permit me, in conclusion, to express my special obligations to the members of the Rumford Committee for directing their attention to my labors, and for the very favorable view which they have taken of their merits.

The President then introduced Dr. Burt G. Wilder, who presented the following communication: —

On the Nephila Plumipes, or Silk Spider. By BURT G. WILDER, S. B., late Surgeon 55th Mass. Vols.

AT the north end of Folly Island, which lies just south from the harbor of Charleston, S. C., on the 20th of August, 1863, I found in a tree a large and very handsome geometrical spider, whose web was about three feet in diameter. While examining the insect at my tent, it occurred to me to see how much of the silken thread could be drawn from the spinners. As it was not disturbed by pulling out a few yards, I wound the thread around a quill, and then, by turning this in my fingers, reeled off silk from the body of the spider for one hour and a quarter, at the rate of six feet per minute, making one hundred and fifty yards of most beautifully shining golden silk. This specimen is still in my possession, and, having been removed from the quill, weighs one third of a grain. I had never before seen this spider, nor had I ever heard of this method of obtaining a silken material; but when, during the following summer, another officer of our regiment * described to me a large spider as very common upon Long Island, which lies just west from Folly Island, I knew it was the same, and told him what I had done, adding that I was sure something would come of it in time. By substituting a cylinder worked by a handle for mine turned in the fingers, this officer obtained more of the silk, winding it upon rings of hard rubber, and afterward, by using a "gear-drill stock," another officer † accomplished similar results still more rapidly.

With this "gear-drill stock" I wound from a number of spiders *three thousand four hundred and eighty yards* of silk upon the periphery and over the sides of a hard rubber ring; the length being accurately measured by multiplying the dimensions of the ring where wound upon by the number of revolutions per minute, and this product by the number of minutes of actual winding. This was in the fall of 1864, and in February, 1865, I showed specimens of the spider and of the silk to Professors Wyman, Agassiz, and Cooke of Harvard University, neither of whom had ever heard of this way of obtaining silk, nor, with the exception of Professor Wyman, — who found a single individual among some specimens collected at the South, — had they ever seen the insect. At this time, too, a friend ‡ to whom the whole history of the

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* Major Sigourney Wales, 55th Massachusetts Volunteer Infantry.

† Lieut.-Col. Charles B. Fox, 55th Massachusetts Volunteer Infantry.

‡ Dr. William Nichols of Boston.

matter was known, expressed his confident belief that this new silken product could be made of some practical utility, especially in view of the anticipated scarcity of ordinary silk; and it is in great measure due to his advice and assistance that the experiments and investigations recounted below have been made.

The only mention of this spider is in the German work of C. L. Koch, "Die Arachniden," where in Vol. VI. is described, under the name of *Nephila plumipes*, a mutilated female specimen, the only one ever collected, and which is preserved in the museum of J. Sturm at Nuremberg. This description and its accompanying figure are very imperfect, but until a careful comparison can be made between the original specimen and some of my own, I will consider the latter as representatives of *N. plumipes;* though an accurate description and figure shall be made as soon as possible.

The following general description applies only to the females, the males being very small and of a different color.

NEPHILA (PLUMIPES ?) Koch. A large and very elegant species of *Nephila*, resembling most of its congeners in the general form of the body, and, like *N. clavipes* and *N. fasciculata*, possessing peculiar collections of stiff hairs upon the legs, but differing from these two species in that these hairs are more closely set so as to justify the German term "Haarbürste" (Hair-brushes).

In general the cepalo-thorax is black above, but covered, except in spots, by silver-colored hairs. The abdomen is olive-brown, variously marked with yellow and white spots and stripes. On the first, second, and fourth pair of legs are one or two brushes of stiff black hairs pointing outward away from the body. The length of the body is one and one tenth inches, and the spread of the legs from two and three fourths in a lateral, to three and three fourths inches in a longitudinal direction. The length of the body of the male is about one third of an inch, and his general color is brown. His palpi are clubbed near the extremities, and end in a sharp point turning outward.

With the exception of the first and only specimen discovered upon Folly Island, and a cocoon found on James Island, I have met with this spider only upon Long Island and one or two similar bits of land in the vicinity. They are all low, sandy, and marshy, covered with palmetto and pine trees, uninhabited, and apparently never before visited by naturalists.

These spiders are specially abundant upon Long Island, and are

found in large geometrical webs, two, three, or four feet in diameter, stretched between shrubs or trees, and often high up among the pines, so as to be out of reach. The webs are strong and of a yellow color; and, as with most species of geometrical spiders, the concentric circles are elastic and studded with numerous viscid globules, while the radii and other parts of the framework are composed of dry and inelastic silk; but with this species the distinction between these two portions of the web consists not only in the viscidity of the former, but also in the color; for while most of the concentric circles are of a bright yellow or golden hue, the radii and stay-lines, and also *every eighth or tenth circle* (the number varies in different individuals), are white or silver-colored. The circles are very near together in proportion to the size of the insect, being only one third or one fourth of an inch apart.

As might be inferred from these facts, but which, so far as I know, has never before been observed, this spider not only has the power of regulating the *size* of its thread, — according as one or two, or three or four of its spinnerets are pressed upon the surface from which the line is to extend, or as a greater or less number of the spinnerules in any one spinneret are employed, — but can also use in the construction of its web either the white or the yellow silk at will; for of its two principal pairs of spinnerets, one, the anterior, yields the yellow, while the other or posterior pair yields the white silk. Of this I satisfied myself by carrying the thread from the anterior pair of spinners upon one part of a spindle, and that from the posterior pair upon another part, guiding them with pins while the spindle was in motion; the result being the formation of two circles of silk, one of a golden, the other of a silver color, as in one of the specimens exhibited; moreover, if while both threads are being drawn out, they are slackened, the lower silver thread will wrinkle and fly up, being inelastic; while the other will contract and, within certain limits, preserve its direction.

There is a corresponding difference in the color of the glands which secrete the gum of which the silk is formed; one set, the more numerous, being yellow, and the other white.

The manner in which the spider deposits the globules of gum on the circles which she wishes to be viscid is not yet explained; at any rate this same yellow silk, when either reeled from the body of the spider, or when employed in the formation of its cocoon, is *dry* and *much less elastic* than that of which the concentric circles are composed.

The evolution of the silk from the spider is almost wholly a mechan-

ical process, and, beyond a certain expansion of the parts, by separating the spinners from each other, the only control exercised by the insect is by means of its hinder legs, the tips of which serve to guide the thread, and by grasping it to control the evolution. I have never been able to reel out over three hundred yards at once from a single spider; but on opening the abdomen, the glands are found still to contain more or less gum. Upon three successive days I obtained equal quantities of silk; so that if, as now seems probable, the emission of the silk is purely mechanical, then a certain degree of preparation is necessary, after it is secreted, before it is ready for use.

The diameter of the silk as spun by the insect, or as reeled from it, varies from one six-thousandth to one thousandth of an inch;* it is exceedingly strong, more so in proportion to its bulk than that of the silk-worm; as is natural, since the spider's thread is made up of hundreds and even thousands of minute fibrils, while the common silk is single. The largest threads are those composing the outer layer of the cocoons, but these are evidently compound, and each of the two, three, or four strands is apparently such as proceeds from the single spinners; the minute fibrils of which have united at once on leaving the spinnerules, so as to form the ordinary silken fibre which generally appears simple under the microscope.

The habits of this spider are very interesting. It seems to obey three principal instincts: first, to ascend; second, to seek the light, whether natural or artificial; and, third, to maintain a position with the head downward. It has eight eye-spots, but, so far as I have observed, it can only distinguish light from darkness, and is not able to see objects. There is not here space to give in detail an account of all that I observed in case of several which made their webs in my room in South Carolina; but all seems to indicate that these spiders do not *see*, as the term is generally understood; the touch is, however, very acute, and is exercised by the palpi and by the tips of the legs, specially the anterior pair. Unlike some other geometrical spiders, it seizes its prey at once in its jaws, and never envelopes it in a silken net till it has expired. The sense of hearing is evidently very acute.

It is very quiet in its disposition, and never leaves its web unless molested. The female builds the web, and even carries the male on her back or belly when moving about; she never attempts to bite

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* The micrometer measurements were made by Mr. R. C. Greenleaf.

unless provoked, and may be suffered to run over one's person with impunity.

Perhaps the most remarkable fact in connection with this spider is, that it can be *fed and watered by hand;* a live fly held to its jaws is seized as soon as a buzz makes its presence known; so also a bit of chicken-liver, if touched to the jaws; and if a drop of water be presented on a camel's-hair pencil, it will be readily taken and gradually swallowed. It is evident that the spiders drink the drops of water which are left in the web from the rain or dew; and they thrive best in a moist atmosphere.

The female lays four or five hundred eggs, half as large as a pin's head, and slightly agglutinated together in a rounded mass, which is secured on the lower side of a leaf by a strong silken cocoon of loose texture, and varying in color. Many of the eggs which were laid by my spiders in September were hatched in about thirty days. The young differ much from the adult in form and color; and the changes which they pass through in growth will prove a most interesting branch of the subject. The young do not leave the cocoon for some time; and even after they have, are more or less gregarious, — always keeping in companies, and preserving good order while moving. They need water, and, if not supplied with food, are prone to eat one another. If properly attended to, they grow quite rapidly;* and although at first they make only an irregular web in common, yet after they have attained a length of half an inch, they will, if separated, construct regular geometrical webs.

In a state of nature, not many over one per cent of the spiders which are hatched live to maturity; so that the question of a practical value of this silk depends upon the success of the attempts to prevent this destruction, which is apparently due to their own voracity, to the elements, and to other insects.

Much more might be related concerning the habits of the insect, of the manner of keeping and feeding the young, of the means of securing the spider while its silk is obtained, and of the various apparatus employed; but I am so impressed with the peculiarities thus far observed in themselves, and with the beauty and strength of the silk, that if time and means permit I shall continue the inquiry as far as possible. And having now, as I hope, established my claim to the

* Feb. 23d, 1866. Some of these young are now more than an inch in length.

discovery of this new method of obtaining a silken material, (namely, by a reeling or circular motion applied to the insect itself,) I will defer to a future occasion a more complete account of the spider, of its habits, anatomy, and embryology, and of the various qualities of its silk, with whatever conclusion can be reached concerning the practicability of rearing the young; and also how far it is possible to apply the same process to the silk-worm, and other silk-producing larvæ.

Five hundred and fifty-ninth Meeting.

December 12, 1865. — MONTHLY MEETING.

The PRESIDENT in the chair.

A letter was read from Mr. Samuel Eliot in acknowledgment of his election into the Academy; also letters relative to exchanges.

The President called the attention of the Academy to the recent decease of Dr. John Lindley of London, of the Foreign Honorary Members.

Five hundred and sixtieth Meeting.

January 9, 1866. — MONTHLY MEETING.

The PRESIDENT in the chair.

The President called the attention of the Academy to the recent decease of Colonel James Duncan Graham of the Resident Fellows, formerly an Associate Fellow.

A memoir by Professor Child was presented by title, namely, "Remarks on the Language of Gower's *Confessio Amantis*: a Sequel to Observations on the Language of Chaucer, printed in Vol. VIII. of the Memoirs of the Academy."

Professor Cooke made the following communication: —

On the Aqueous Lines of the Solar Spectrum. By JOSIAH P. COOKE, JR.

A CAREFUL examination of the solar spectrum, continued during several months with the spectroscope described in a recent article of the